

Trout Management Plan for Tennessee

2006 – 2016



Edited by

Frank C. Fiss
James W. Habera

Tennessee Wildlife Resources Agency
April 3, 2006




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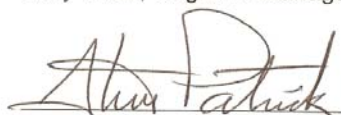
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Table of Contents

Foreword	1
Acknowledgements	1
Current Status	1
Trout Anglers	1
Wild Trout Streams	2
Hatchery-Supported Streams and Small Lakes	5
Delayed Harvest Program	6
Winter Trout Program	7
Tailwaters	7
Reservoirs	9
Private Trout Fisheries	10
TWRA Trout Management Budget and Personnel	11
Trout Hatcheries	12
Mission Statement	15
Management Goals	15
1. Conserve Tennessee's native, southern Appalachian brook trout	15
2. Protect all wild trout waters from habitat degradation	16
3. Integrate trout management with protection of native aquatic ecosystems	16
4. Maintain a variety of trout fisheries	17
5. Increase access to trout fisheries	18
6. Effectively communicate with all trout anglers.	19
7. Optimize use of hatchery trout	19
8. Produce more trout for hatchery-supported fisheries	20
9. Improve the quality of stocked trout.	21
10. Optimize habitat quality in tailwaters managed for trout.	21
11. Manage reservoir trout fisheries for large fish	22
12. Make it easier to go trout fishing in Tennessee.	22
13. Expand trout fishing opportunities for children	23
14. Develop more trout fisheries in middle Tennessee	23
15. Maintain compliance with trout angling regulations	24
16. Limit threats posed by introduced exotic species and pathogens	25
17. Be prepared to meet Tennessee's future trout management challenges.	25
References	26

Foreword

The purpose of this plan is to present the Tennessee Wildlife Resources Agency's (TWRA) goals, objectives, and strategies for the management of trout and the fisheries they provide in Tennessee. The plan provides a foundation for annual recommendations to the Tennessee Wildlife Resources Commission and defines realistic management goals given the availability of wild trout resources and hatchery trout production.

Prior to finalization, we asked Tennessee anglers and other stakeholders, as well as representatives from other state and federal natural resource management agencies, to review the plan and provide input. We received numerous comments and recommendations from these sources which were generally supportive of the goals and strategies outlined in the initial draft. Public input was incorporated where feasible, especially in strategies for Goals 4 and 15, although suggestions that applied to the management of specific streams or tailwaters (e.g., stocking rate changes) were beyond the scope of the plan and were not included.

Acknowledgements

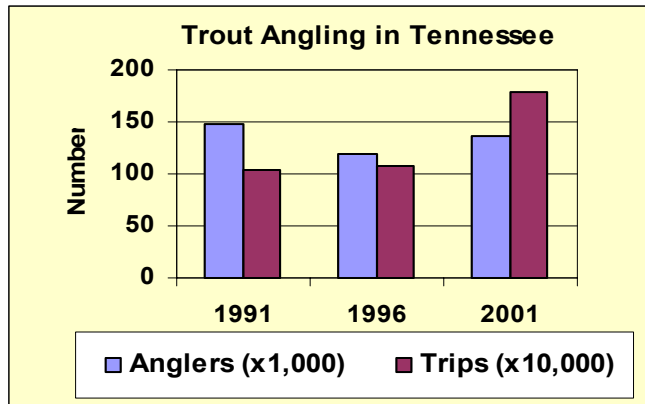
The management goals outlined in this plan were developed by a TWRA committee of coldwater fishery specialists from across the state: Frank Fiss (Program Coordinator), Jim Habera (Wild Trout Biologist, Region 4), Travis Scott (Flintville Hatchery Manager, Region 2), Jack Swearingen (Fisheries Manager, Region 3), and Bobby Wilson (Assistant Chief of Fisheries). Additional comments were provided by other TWRA staff: Rick Bivens, Tim Broadbent, Bart Carter, Tim Churchill, Michael Clark, David Lane, Jim Negus, Dave Rizzuto, Danny Scott, and David Young. Roy Hawk donated several of the photographs used in the plan. Finally, we would like to thank everyone, especially Tennessee's trout anglers, who took time to read and comment on the initial draft plan. Your input helped produce what we believe will be a successful plan for managing our trout fisheries.

Current Status

Before considering any plan for guiding future trout management, it will be helpful to review current information regarding Tennessee's trout anglers, the different trout programs available to them, and TWRA's trout fisheries management and hatchery resources. Management of Tennessee's trout fisheries is a multi-faceted process that seeks to provide a variety of opportunities and experiences for many types of anglers.

Trout Anglers

The U.S. Fish and Wildlife Service (USFWS) surveys anglers across the nation every five years to track trends in recreation. Based on surveys conducted in 1991, 1996, and 2001, an average of 135,000 resident and non-resident anglers fish for trout in Tennessee annually. They



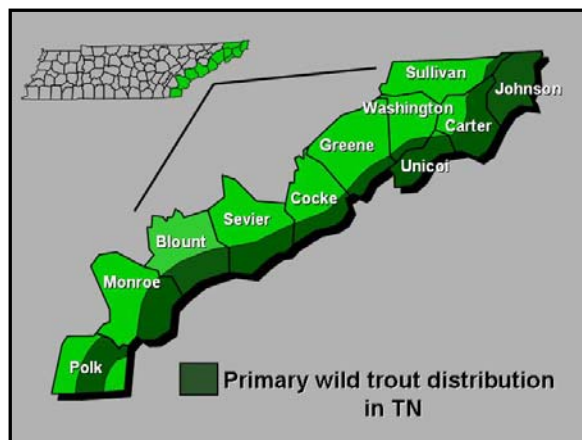
represent about 16% of all anglers. Trout anglers made 1.8 million trips in 2001. The estimated total expenditure associated with these trips was approximately \$77 million.

TWRA also collects information about resident anglers through telephone surveys conducted by the University of Tennessee. The most recent survey conducted in 2003

helps describe the typical trout angler. The average trout angler fished 9.4 times and average trip length was 4.7 hours. Only 10% of the anglers surveyed reported catching a brook trout (*Salvelinus fontinalis*), while 40% caught brown trout (*Salmo trutta*), and 83% reported catching rainbow trout (*Oncorhynchus mykiss*). On the average trip, five rainbow trout were caught and two were harvested. About 58% of trout anglers used bait, 61% used artificial lures, and 38% used flyfishing gear. Thirty-three percent used bait exclusively, and 15% always used flyfishing gear. Eighty percent of trout anglers were satisfied with TWRA's management of trout fisheries and 8% were somewhat to very dissatisfied.

Although it is easy to calculate statistics to describe the average trout angler, the results are often misleading because of the specialization among anglers. For example, some anglers never harvest fish, while others always harvest fish. An average of these behaviors would imply that the average angler harvests fish half of the time. This, however, does not accurately reflect the true behavior, as neither angler type is well represented. While TWRA does track the easily calculated averages, managers are aware of the wide variety of anglers that fish for trout.

Wild Trout Streams



Tennessee is fortunate to have a relatively abundant wild trout resource. A wild trout can generally be defined as having spent its entire life cycle (egg through adult) in the wild. Populations of these fish are self-sustaining and require no stocking to survive. Because wild trout have specific habitat requirements (for water temperature, flow, spawning substrate, etc.), their distribution in Tennessee is primarily limited to the eastern part of the state (TWRA's Region IV), where they inhabit over 600 miles of coldwater

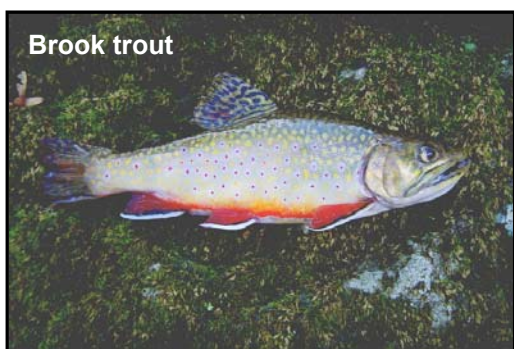
streams in the Blue Ridge Mountains. About 70% of this wild trout habitat is located within the 625,000-acre Cherokee National Forest (CNF). The remainder occurs on privately owned lands and includes some of Tennessee's best wild trout streams. Additionally, the Tennessee portion

of Great Smoky Mountains National Park (Blount, Sevier, and Cocke counties) contains another 245 miles of wild trout streams managed by the National Park Service. As recently as the early 1950s, several of Tennessee's larger coldwater streams including Beaverdam Creek, Doe Creek, and Tellico River had habitat limitations and few produced wild trout (Shields 1950, 1951). Today, these streams, along with many others, provide excellent wild trout fisheries.



Rainbow trout, brown trout, and brook trout comprise Tennessee's wild trout populations. Rainbow trout are the most abundant and widely distributed wild trout in Tennessee. Although native to Pacific drainages of the western U.S., rainbow trout became naturalized in many suitable Tennessee streams through the intensive stocking efforts that defined trout management during much of the twentieth century. Brown trout are native to Europe and Asia and, like rainbows,

became naturalized in Tennessee through stocking. While not as widely distributed as rainbow or brook trout, brown trout can live longer (up to 12 years) and attain larger sizes (up to 25 inches or more). They typically occur with rainbow trout, but are the predominant wild trout species in a few streams, such as Laurel Fork and Paint Creek in east Tennessee.



Brook trout are Tennessee's only native trout and once occurred at elevations as low as 1,600 ft. in some streams (King 1937). Habitat degradation (especially logging prior to the 1930s) and other land use changes, coupled with competition from introduced rainbow and brown trout, caused substantial brook trout distribution losses during much of the previous century (King 1937; Bivens et al. 1985).

Consequently, they now inhabit about 150 miles in 107 streams and represent about 25% of Tennessee's wild trout resource outside the Great Smoky Mountains National Park. Despite widespread stocking of brook trout over the years, genetic analyses have shown that 53% of Tennessee's brook trout populations are of native, southern Appalachian heritage (Habera et al. 2001). The remaining populations are descended from hatchery-produced fish derived from northern brook trout stocks or consist of hybrids. Through the cooperation of TWRA, the U.S. Forest Service, Trout Unlimited and others, many of Tennessee's brook trout populations on the CNF were renovated or enhanced during the 1980s and 1990s by constructing barriers and removing non-native rainbow trout. Brook trout distribution losses related to rainbow trout encroachment appear to have stabilized for now (Strange and Habera 1998; Habera et al.



2001), thus there is currently less emphasis on controlling rainbow trout. However, brook trout populations are still subject to habitat degradation and other threats.

Tennessee's wild trout streams are quite pleasing aesthetically, but most have a limited capacity for producing trout. Their extremely soft waters lack dissolved minerals (alkalinities are usually ≤ 20 ppm as CaCO_3) because of the underlying geology, causing

them to be naturally infertile as well as poorly buffered against pH changes. Food is the primary limiting factor to trout populations in these streams, particularly during the summer months when trout metabolic rates are highest (Cada et al. 1987; Ensign et al. 1990). Consequently, Tennessee's wild trout are relatively small and short-lived (most do not exceed 10 inches or three years of age) and average abundance is relatively low (28 lbs./acre; Habera et al. 2003). Wild trout populations throughout the southern Appalachian Mountains are similar (Habera and Strange 1993). Trout production, which is positively correlated with alkalinity (Kwak and Waters 1997), appears to increase in Tennessee streams where alkalinity exceeds 40 ppm, such as those influenced by springs. While the upper limit for wild trout abundance is about 100 lbs./acre in Tennessee, it can be much higher in other regions where streams are naturally more productive (Platts and McHenry 1988; Behnke 1992). The abundance and size structure of wild trout populations in typical southern Appalachian streams can be substantially improved by supplemental feeding (Borawa et al. 1995), providing further evidence of the extent of food limitation.



Wild trout (especially native brook trout) are important ecologically and because of the fisheries management opportunities they offer. Wild trout populations reflect the quality and stability of the aquatic systems they inhabit, which are linked to the quality and stability of associated terrestrial systems. Recreational fishing for trout and salmon is extremely popular throughout the United States (Epifanio 2000) and wild trout support much of this activity. In Tennessee, 44% of trout

anglers have indicated that they fish for wild trout (Stephens et al. 1997). Accordingly, protecting and enhancing wild trout was ranked, in a recent survey of state fisheries agencies, as the most important issue addressed by their coldwater fisheries management plans (Born and Stairs 2003). Wild trout are an important component of TWRA's current strategic plan for managing Tennessee's streams and rivers and are particularly valuable as they expand the number and variety of trout fishing opportunities available to increasingly specialized anglers at

very little cost. Most wild trout streams in Tennessee are currently managed with TWRA's statewide trout regulations: daily creel limit of seven fish, no gear restrictions, and a 6-inch size limit on brook trout. Special wild trout regulations with reduced creel and size limits were established on several streams in the late 1980s, but they function mainly to diversify angling experiences. Such regulations have little potential to affect wild trout populations given the biological limitations described previously and current levels of pressure and harvest (Habera et al. 2004). Tennessee's wild rainbow and brown trout fisheries in larger streams developed over the years from hatchery-supported fisheries. Stocking has continued in a number of these streams to meet angler expectations.

Hatchery-Supported Streams and Small Lakes

Wild trout are generally limited to East Tennessee's mountain streams, but the demand for trout fishing is nearly statewide. For over 50 years, managers have addressed this demand for trout fishing opportunities by stocking selected streams across the state. These hatchery-supported streams and lakes are primarily warmwater habitats that do not support trout year round. Some streams that support wild trout populations are also stocked with trout. These are typically waters with low wild trout productivity or extremely high fishing pressure, like Tellico River.



Approximately 310,000, 9- to 11-inch rainbow trout are stocked into 77 hatchery-supported streams and lakes in Tennessee annually. Stocking rates vary from 500 to 75,000 trout annually and are largely based on historical rates that reflect the amount of access, anticipated fishing pressure, and availability of trout. Most trout are harvested within a few weeks after stocking, so streams are typically stocked multiple times throughout the season to maintain better catch rates. Stocking

frequency ranges from weekly to monthly, and the duration of the season largely depends on the temperature regime for individual streams. Most are stocked from March through June, while others can be stocked through September. These stocked waters provide trout fishing opportunities for many anglers that never get the chance to fish for wild trout. Because survival of stocked trout is usually limited by summer water temperatures, harvest of trout in these waters is generally encouraged. Regulations typically permit the harvest of seven trout per day with no size restrictions.

Many anglers observe that fishing is best right after TWRA stocks and want to know the stocking schedule. The stocking schedule is printed in the annual fishing guide and posted on the TWRA website to let anglers know approximately when the fish will be stocked. The location of hatchery-supported streams can also be viewed on maps provided at the TWRA

website. The schedule lists the week that a particular location will be stocked and the hatchery has the option of stocking any day during that week. Although most anglers would prefer to know the actual stocking date, such forecasting would not give hatchery managers sufficient operational flexibility. Announcement of a set stocking date would also tend to attract too many anglers to a location, resulting in logistical problems for hatchery truck drivers and potential conflicts between landowners and anglers.

Many hatchery-supported streams are located on private property. Anglers are expected to obtain permission to fish and landowners are generally expected to grant permission. If landowners routinely deny permission, then that location is removed from the stocking list. Lack of access is the typical reason for removing a stream from the stocking list.

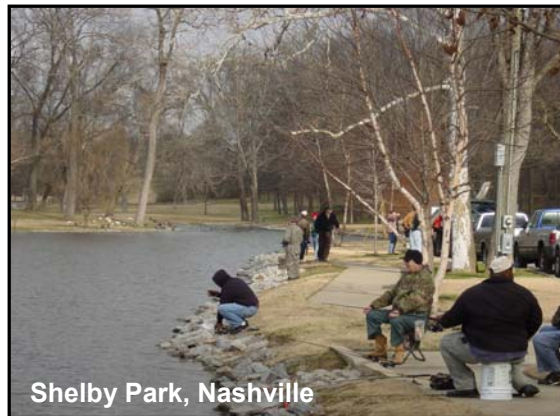
TWRA frequently receives requests to stock new waters, but these requests are rarely granted. TWRA biologists must determine that the risk of damaging native fauna by stocking trout is low relative to the benefits of establishing a new fishery. In some circumstances, an introduced population of wild trout could have irreversible effects on native aquatic fauna. Biologists must carefully evaluate each new location to make sure that there is little risk to native species. They must also determine that the fishery will benefit the public. Selected locations should be large enough to support a fishery and have adequate public access and parking.

TWRA funded two research projects on hatchery-supported streams in the 1990's. One study evaluated three streams (Mill Creek, Battle Creek, and Big Creek) and found that catch rates ranged from 1.0 to 1.9 fish/hour during the week following stocking and only 23% of the stocked trout were harvested (O'Bara and Eggleton 1995). They concluded that most of the unharvested fish go unused by anglers. Bates (1997) estimated that 95% of the trout stocked into Tellico River are harvested by anglers. Additional research to determine the minimum stocking rates that optimize angler satisfaction is warranted.

Delayed Harvest Program

Delayed harvest areas have become popular in several states and were first introduced in Tennessee in Gatlinburg during 1997. Subsequently, TWRA established delayed harvest areas in the Cherokee National Forest on Paint Creek and Tellico River in 2001. The goal of TWRA's delayed harvest program is to provide additional fall and winter fishing opportunities with relatively few hatchery trout. This is achieved by lightly stocking streams in October and allowing catch-and-release angling until March, when harvest is again permitted. Bait fishing is prohibited during the catch-and-release season to improve survival of released fish. The date the stream re-opens to harvest coincides with the traditional stocking season. TWRA has not yet evaluated these relatively new fisheries.

Winter Trout Program



The winter trout program is also designed to provide angling opportunity during the winter months. Whereas the delayed harvest program is designed for more experienced anglers, the winter trout program is designed to recruit new anglers from urban areas, particularly where there are few or no other trout angling opportunities. Winter trout events are typically located near town centers on public property with ample parking. Stocking dates are published well in advance of each event and

higher stocking rates are used to assure high catch rates.

The winter trout program began in 1999 at J. Percy Priest Tailwater in Nashville. Initially, 14,000 9- to 10-inch rainbow trout were stocked monthly between December and March. This event's popularity was documented by a creel survey that estimated 779 trips during a 17-day period, and by a substantial increase in local trout license sales. Since 1999, the program has spread to 26 locations from Memphis to Chattanooga, with 78,000 trout stocked during the 2005/2006 season. The additional trout that permitted expansion of this program were provided by innovative production techniques at Flintville Hatchery and Dale Hollow National Fish Hatchery. This has become a popular program and TWRA receives requests to stock new locations annually. However, additional program growth is limited by hatchery production, which is now at capacity.

Stocking rates have never been evaluated for the winter trout program, so further expansion may be possible by changing stocking rates at existing locations. Given the high number of fish that the winter trout program could potentially require in future years, research is warranted to determine the minimum stocking rate that would still provide high catch rates for novice anglers.

Tailwaters

Cold water released from hydropower dams operated by the Tennessee Valley Authority (TVA) and the U.S. Army Corps of Engineers (USACE) have extirpated fish populations that formerly occurred downstream. TWRA and USFWS stock trout below these dams to mitigate for the lost fisheries and TWRA is committed to creating quality trout fishing opportunities in these altered habitats. TWRA manages 13 tailwaters located in middle and East Tennessee. All differ in water quality, instream habitat, and potential for trout production. Consequently, TWRA manages each tailwater differently with respect to stocking and fishing regulations. TWRA has written specific management plans for the Wilbur, South Holston, Norris, Center Hill, and Apalachia tailwaters (available at TWRA's website) and will prepare written plans for the remaining tailwaters in the next few years. TWRA biologists survey most tailwaters annually to document trout abundance and size distributions. Much of the funding for TWRA's fisheries



research is committed to conducting angler surveys and trout research on tailwaters. All this information helps TWRA optimize stocking rates, evaluate proposed regulations, develop new management techniques, and ultimately improve the fisheries.

Creel surveys conducted since 1995 (e.g. Bettoli 1996a; Bettoli 2004) conservatively estimate that anglers make over 130,000

fishing trips to Tennessee tailwaters each year. Angler use varies annually at each tailwater and is primarily controlled by generation schedules. Lightly to moderately fished tailwaters (3,000 to 10,000 trips/year) include Dale Hollow, Normandy, and Tims Ford. Heavily fished tailwaters, such as Wilbur, Norris, South Holston, Apalachia, and Center Hill, typically support 20,000 to 25,000 trips per year. The average angler spends between \$29 and \$129 per trip depending on the tailwater. The total economic value of these eight tailwaters, estimated by adding trip expenditures to consumer surplus value, was \$8.8 million in 2001 (Williams and Bettoli 2003). This estimate was based heavily on travel costs and the top three tailwaters based on economic value were Center Hill, Hiwassee, and Dale Hollow.

Average catch rates over 0.7 fish/hour are generally considered representative of good fishing (McMichael and Kaya 1991; Wiley et al. 1993) and most of Tennessee's tailwaters exceed this standard. Creel surveys conducted since 2000 have reported catch rates varying from 0.6 to 2.6 trout/hour. Like most fisheries, relatively few anglers caught most of the fish. Most anglers caught few fish during a trip regardless of the tailwater. Depending on the tailwater, total catch during an average trip ranged from 2 to 10 trout, with harvest ranging from 0.2 to 3.0 trout per trip. Brown trout represented a small percentage (10-20%) of the trout caught.

Hutt and Bettoli (2003) recently studied the recreational preferences of tailwater anglers in Tennessee. These anglers fished 32 days per year, had nearly 16 years of experience fishing for trout, and were twice as likely to use bait (68%) compared to artificial lures and flies (32%). The study also identified five distinct groups of anglers that fish Tennessee tailwaters. These groups are defined by anglers whose experience varies from novice to expert and who may, or may not, harvest fish. Such diversity challenges TWRA to provide something for all types of tailwater trout anglers.

TWRA, in cooperation with Dale Hollow National Fish Hatchery, stocks approximately 1.5 million trout into tailwaters each year. Stocking rates, species and sizes vary among tailwaters, but all are stocked with 9-inch rainbow trout. Smaller trout (fingerlings) are also stocked where they are capable of growing to desirable sizes and account for over 600,000 of the trout stocked into tailwaters annually. Fingerling stocking has been most successful at Norris, Wilbur, and South

Holston tailwaters. Brown trout are stocked into most tailwaters, although at much lower rates than rainbow trout. The Normandy, J. Percy Priest, and Ocoee tailwaters do not have cold water year-round and receive only 9-inch rainbow trout seasonally. The Wilbur tailwater has been stocked with brook trout since 2001 to develop a river fishery for this species that is normally found only in smaller streams at higher elevations.

Historically, many of Tennessee's tailwaters were limited by poor water quality and inadequate flows. Poor water quality reduces trout growth and survival, making higher stocking rates necessary to maintain angler catch rates and limiting the potential for producing quality-sized fish. Installation of weirs and oxygen injection systems, establishment of minimum flows, and other efforts by TVA over the past decade have greatly improved water quality below many of its dams (Scott et al. 1996), particularly South Holston, Cherokee, and Norris. Recent operational improvements at Center Hill Dam by the USACE have greatly improved water quality. However, additional improvements are needed at Center Hill and Dale Hollow tailwaters to improve these fisheries.

Natural reproduction has been documented in the South Holston, Wilbur, and Norris tailwaters. Brown trout reproduction in the South Holston tailwater has been consistent and substantial in recent years. For this reason, TWRA stopped stocking brown trout into the South Holston tailwater in 2004 to create a unique wild trout fishery. The Wilbur tailwater is the second best producer of wild fish, followed by the Norris tailwater. Natural reproduction is too low in the Wilbur and Norris tailwaters to warrant reduced stocking rates.

TWRA uses a variety of fishing regulations to maintain and improve quality fishing in tailwaters. Most are under statewide regulations that include a seven trout creel limit with no size restrictions. Quality zones on the Wilbur and Apalachia tailwaters limit harvest to two trout over 14 inches and bait is prohibited. Quality zones were implemented to maintain high catch rates and improve fish size. The bait restriction reduces catch-and-release mortality and diversifies angling experiences. Seasonal closures of spawning areas and a 16 to 22-inch protected length range (PLR) on the South Holston tailwater were enacted to protect large spawning trout. More restrictive regulations for brown trout in the Apalachia (14-inch minimum, limit of two) and Center Hill (18-inch minimum, limit of two) tailwaters were recently established in an attempt to increase the abundance of quality trout.

Reservoirs

Stocking trout in reservoirs helps diversify angling opportunities in these waters. Only reservoirs that have a year-round supply of well-oxygenated cold water can support trout fisheries. Tennessee has seven reservoirs that currently support trout fisheries: Dale Hollow, South Holston, Watauga, Fort Patrick Henry, Calderwood, Chilhowee, and Tellico (~60,000 acres total). Some reservoir trout attempt to spawn in tributaries, but these attempts are largely unsuccessful and stocking is required to maintain reservoir fisheries. Trout are stocked during



the winter to assure that surface water temperatures are cold enough for their survival. Approximately 190,000 9-inch rainbow trout are stocked into Tennessee reservoirs annually. Lake trout (*S. namaycush*) are produced for Watauga and Chilhowee reservoirs and about 100,000 7-inch fish are stocked each year. Brown trout stocking was initiated in Dale Hollow and South Holston reservoirs during 2001

(20,000 trout/reservoir) to create new fisheries, but few anglers have reported catching any. The timing of brown trout production yields a 6-inch brown trout for winter stocking. These smaller trout may be more vulnerable to predation compared to the 9-inch rainbow trout that seem to have better survival.

Length restrictions cannot be used to manage reservoir trout fisheries during the summer because surface temperatures are too warm to safely release fish. TWRA restricts harvest of trout during the winter on South Holston and Dale Hollow reservoirs to allow trout to grow larger before being harvested and to limit the harvest of freshly stocked fish. Most successful anglers catch trout in reservoirs by targeting them in the summer months when trout are limited to deep-water habitat. Anglers commonly troll lures with downriggers or fish bait suspended in deep water. Catch rates are typically low on reservoirs (< 0.25 trout per hour, Bettoli 1996b; Malvestuto and Black 2003), although Calderwood produced catch rates of up to 0.6 trout per hour in 1999 (Yow et al. 2002).

Compared to other fisheries, little is known about trout in Tennessee's reservoirs. Where creel surveys have been conducted, the number of fish harvested was typically very low (<10 %) relative to the number stocked. Despite such low return rates and relatively low use by anglers, TWRA managers have continued to support a reservoir trout program because of its potential to provide unique fisheries that could possibly be enhanced if more information were available.

Private Trout Fisheries

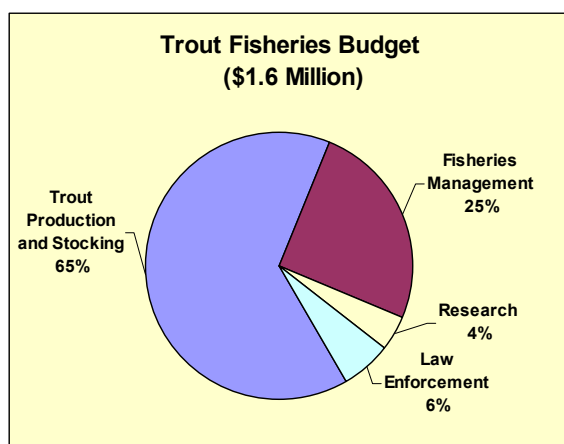
Private trout fisheries are ponds or streams where all access is privately controlled and landowners charge a fee to fish. Some operations use feeding stations to keep fish from leaving the area and to produce larger trout. Some rely on wild trout and others stock trout to sustain populations. Currently, there are only a few private trout fisheries in Tennessee. TWRA's angler recognition program (TARP) has documented that some of these streams routinely produce trophy trout.

Privately-managed trout waters have the potential to provide unique fishing opportunities for anglers that are willing to pay for the experience, but there are risks. The primary concern is that a potentially harmful species of fish would be introduced, or that a disease, parasite or

some other exotic organism could be released with the trout. The spread of exotic species is a major threat to aquatic ecosystems (Simon and Townsend 2003; Dunham et al. 2004). TWRA uses disease-free eggs and monitors its hatchery for pathogens regularly to reduce this risk. Currently, it is illegal to stock streams without TWRA's permission. Landowners who want to establish hatchery-supported private fisheries must obtain permission from TWRA to release fish. TWRA rarely grants permission because the risk of harmful introductions is high relative to the potential public benefit.

As private trout fisheries become more commonplace, a market for fishing opportunity will be established (much as it has for deer hunting opportunity). Once a price is set, other landowners may be less willing to allow "free" fishing on their land. This could impact many anglers because nearly all trout fishing outside the National Forest occurs on private land. However, such a scenario may cause landowners to value their stream aquatic resources more, making them stronger advocates for healthy streams.

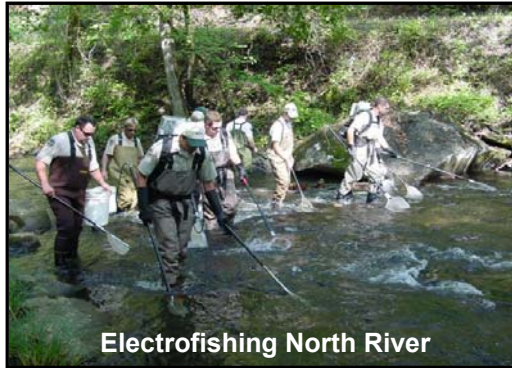
TWRA Trout Management Budget and Personnel



License fees and Tennessee's share of federal funding pay for trout management, research, stocking, and enforcement of fishing and water quality regulations. The budget for TWRA's trout management program is approximately \$1.6 million annually. There are 3 to 4 stream management positions in each of TWRA's four regions and a program coordinator in the Fisheries Management Division (Nashville). All 14 positions of this management team split their time among multiple TWRA programs, but primarily

work with the trout and warmwater stream programs. The resources dedicated to trout management vary from region to region in proportion to the number of trout fisheries being managed. Because producing and stocking fish are integral parts of TWRA's trout management efforts, trout fisheries currently consume, mile for mile, more agency resources than typical stream bass fisheries.

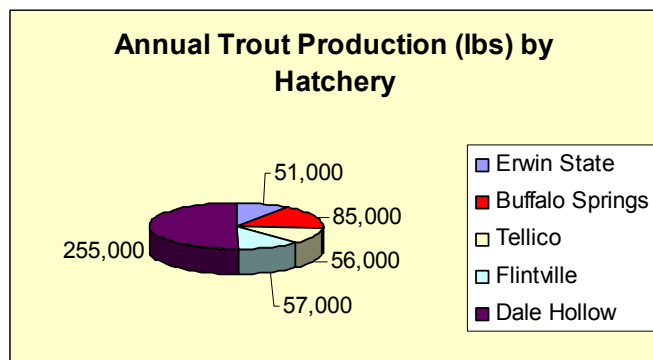
The trout management team in each region is responsible for monitoring trout populations and habitat, recommending regulations and stocking rates, and communicating with anglers to stay informed of local issues. The regional trout management teams are the local experts. The trout program coordinator provides guidance and support for the regional teams, directs research, prepares strategic plans and reports, and maintains databases on fisheries statewide.



County Wildlife Officers schedule a portion of their time to enforce trout fishing regulations and water safety. When warranted, several officers may cooperate to perform special details designed to increase compliance. These operations are often covert and not visible to the public. Trout anglers highly value enforcement activity, and TWRA frequently receives requests for additional enforcement on trout streams (especially hatchery-supported streams and

tailwaters). Officers play an important role in communication between anglers and TWRA. In addition, some officers help stock trout and monitor trout populations.

Trout Hatcheries



TWRA operates four trout hatcheries: Buffalo Springs Hatchery, Erwin State Hatchery, Tellico Hatchery, and Flintville Hatchery. These hatcheries produced approximately 250,000 pounds of trout (~ 1 million trout) at a cost of about \$1 million in 2005. An additional 1.3 million trout were produced by Dale Hollow National Fish Hatchery (DHNFH), which is operated by

the USFWS. The Erwin National Fish hatchery also stocks about 10,000 pounds of large brood fish (12-18 inches) annually. Two TWRA warmwater hatcheries (Eagle Bend and Normandy) also play a minor role in annual trout production (<1,000 pounds).

Buffalo Springs Hatchery receives eggs from disease-free sources, such as Erwin National Fish Hatchery, incubates and hatches the eggs, then rears trout to various sizes up to 11 inches. Buffalo Springs supplies Erwin State Fish Hatchery with fingerling (5-inch) rainbow trout as their starter fish. Similarly, Buffalo Springs provides 6-inch rainbow trout to the City of Gatlinburg's hatchery to be grown out and stocked in Gatlinburg streams. Buffalo Springs also produces fingerling brook trout. The bulk of Buffalo Springs' production supplies trout for hatchery-supported streams, reservoirs, and tailwaters in east Tennessee.

Erwin State Hatchery rarely handles eggs; it relies instead on starter fish from Buffalo Springs Hatchery. Most fish reared at Erwin State Hatchery are 10-inch rainbow trout to be stocked in hatchery-supported streams in upper east Tennessee.

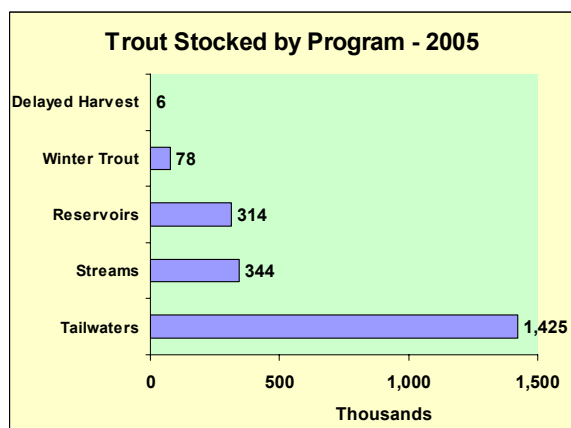
Tellico Hatchery receives 8 to 9 inch rainbow trout from DHNFH. These fish are then grown to 11 to 12 inches and stocked frequently into the Tellico River, Citico Creek, and Green Cove Pond. This intense management requires additional fees to support the program and a special

Tellico-Citico permit is required to fish these waters. Several Polk County streams are also stocked with trout from Tellico Hatchery.

Flintville Hatchery was established in 1933 and is Tennessee's oldest trout hatchery. This hatchery grows rainbow trout from eggs to a variety of sizes for waters in middle Tennessee. Flintville's trout are primarily stocked in hatchery-supported streams and winter trout areas, as well as a few tailwaters.

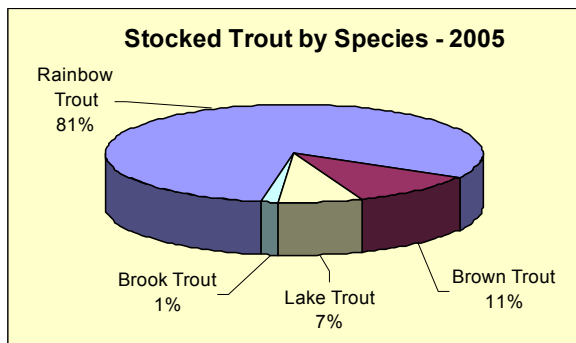


Tennessee relies heavily on trout from DNHFH to support fisheries in tailwaters and reservoirs, and to supply trout to Tellico Hatchery. DNHFH produced 255,000 pounds of trout (1.3 million fish) in 2005 to mitigate for fisheries that were permanently lost due to the construction and operation of dams. Nearly all brown trout stocked in Tennessee are from DNHFH and its production of brown trout is currently at capacity.



Hatcheries are currently operated at capacity, but total production is 150,000 pounds short of what TWRA desires for managing its various stocking programs at optimum levels. An independent evaluation of TWRA's trout hatchery system in 2004 determined that much work is needed to maintain existing production and identified options to increase production (FISHPRO 2004). A major issue was the aged infrastructure at Flintville Hatchery, where required maintenance includes

replacing spring collection pipes, water lines, and raceways at an estimated cost of \$4.4 million. The evaluation also found that production could be increased by adding liquid oxygen aeration systems at Buffalo Springs, Erwin State, and Flintville at a cost of \$600,000. TWRA would like to meet future needs by upgrading existing hatcheries and building a new hatchery. A new hatchery would cost about \$12 million. Assuming funding is available, repairs and construction of a new hatchery will take several years to complete. This management plan will identify uses for additional trout, but will not rely on new construction to solve existing trout supply limitations.



TWRA hatcheries currently employ 14 full-time employees. Hatchery staff are responsible for the production and delivery of trout according to the schedule developed by the management team. Hatchery staff also serve a major role in educating the public about the trout program and other TWRA programs. Over 60,000 people visit TWRA hatcheries each year.

Mission Statement

“Provide a variety of quality trout angling opportunities that are compatible with Tennessee’s other aquatic resources.”

Management Goals

GOAL 1. Conserve Tennessee’s native, southern Appalachian brook trout.

Objective: Maintain Tennessee’s existing southern Appalachian brook trout populations at approximately 80 miles distributed among 57 streams, and expand this resource where appropriate.

Problems: Brook trout represent only one fourth of Tennessee’s wild trout resources and native, southern Appalachian brook trout make up only half of the brook trout resource. These ecologically and recreationally important fisheries face a number of threats, including habitat degradation, non-native species, and loss of genetic integrity through improper stocking practices.

Strategies:

1. Endorse and implement the management actions and guidelines recommended by the American Fisheries Society’s Southern Division Trout Committee in its position statement on managing southern Appalachian brook trout (SDAFSTC 2005). This document addresses issues important to the conservation of southern Appalachian brook trout, including habitat protection and improvement, taxonomic status, hatchery brook trout stocking by TWRA and private landowners, and population restoration and enhancement.
2. Participate in the Eastern Brook Trout Joint Venture. This is a multi-agency effort to assess the current status of wild brook trout populations and develop a comprehensive conservation strategy across the entire range of brook trout in the eastern United States (Maine to Georgia).
3. Promote the importance of native, southern Appalachian brook trout by featuring them in various Agency displays (e.g., at fishing and outdoor shows), publications (e.g. the forthcoming wild trout map), and presentations. TWRA recently cooperated with the Tennessee Aquarium in its efforts to feature native fishes at its facility in Chattanooga. Nearly 100 southern Appalachian brook trout were collected from Carter County streams and these fish are now on display, and will be accompanied by descriptions of their status and importance.

GOAL 2. Protect all wild trout waters from habitat degradation.

Objective: Lose no wild trout populations to habitat degradation and limit impacts on wild trout where some habitat degradation is unavoidable.

Problems: Land use changes, water withdrawals such as those affecting Doe Creek, road construction, and other development-related activities threaten or have already impacted wild trout habitat.

Strategies:

1. Verify compliance with Clean Water Act (Section 404) dredge and fill permits and Aquatic Resource Alteration Permits where wild trout habitat is potentially affected.
2. Promote the use of Best Management Practices (BMPs) and Farm Bill projects in watersheds where soil-disturbing activities may impact wild trout habitat.
3. Publicize BMPs and the benefits of improved water/habitat quality by publishing success stories in local newspapers showing how whole communities benefit, not just fish and anglers.
4. Ensure that all waters actually supporting wild trout are subject to Tennessee Department of Environment and Conservation (TDEC) water quality standards and usage classifications designed to protect wild trout (TDEC 2004).
5. Place information on TWRA's website, in *Tennessee Wildlife* magazine, and other outlets available to landowners regarding all grants and programs available for protecting and improving water quality and trout habitat.

GOAL 3. Integrate trout management with protection of native aquatic ecosystems.

Objectives: Minimize potential impacts of trout stocking on native aquatic ecosystems.

Problems: The introduction of exotic species, such as rainbow and brown trout, could have irreversible negative effects on existing aquatic fauna in some locations. There is also some risk of introducing an exotic parasite, bacteria, or other pathogen at every stocking event. TWRA routinely receives recommendations for new trout stocking locations. Additionally, many landowners seek permission to stock their own streams with purchased trout, and some illegally stock their streams. Private trout stocking without TWRA's oversight eliminates the Agency's ability to assure that fish are disease free and are appropriate for that particular body of water.

Strategies:

1. Thoroughly evaluate candidate locations to determine the effects of stocking on native fauna and consult with:

- The USFWS in cases where federally listed species may be present.
 - The TDEC Division of Natural Heritage where locations in State Natural Areas are involved or in cases where state listed species may be present.
 - State Park managers where locations in State Parks are involved.
2. Stocking of hatchery trout should only occur at locations where the expected benefit to anglers is substantially high and potential impacts from introducing exotic species and non-endemic pathogens is extremely low.
 3. Only purchase fish from private hatcheries that are certified to be free of potentially problematic diseases.
 4. Actively participate in the USFWS National Wild Fish Health Survey to determine the distribution of certain pathogens in wild fish, thereby enabling managers to make risk assessments regarding stocked fish.
 5. Limit introductions of trout to locations where their survival is controlled by summer water temperatures. Likewise, do not stock trout in new locations from which they are likely to enter areas where reproduction could occur and permanent populations could be established.
 6. Minimize the risk of establishing new populations in coldwater streams by stocking sterile (e.g., triploid) trout.
 7. Enforce and advertise existing laws that prohibit the stocking of streams by anyone other than TWRA, unless permission is granted by the Executive Director of TWRA.

GOAL 4. Provide a variety of trout fisheries.

Objective: Offer trout fishing opportunities in streams, tailwaters, reservoirs, and other permanent or temporary habitats that satisfy a diverse public's many definitions of quality.

Problem: The diversity of trout anglers and potential trout habitats in Tennessee require TWRA to provide a variety of angling options. However, management that optimizes opportunities for one group may exclude other groups.

Strategies:

1. Maintain the current array of trout fishing opportunities: wild trout streams, tailwaters, reservoirs, hatchery-supported streams, the winter trout program, and delayed harvest areas.
2. Expand the number of delayed harvest areas (including one tailwater) and winter trout program waters.
3. Maintain existing regulations designed to diversify angling experiences, such as Cherokee National Forest wild trout regulations and tailwater quality zones.
4. Establish a catch-and-release area on one wild trout stream.

5. Continue evaluation of brook trout in the Wilbur tailwater and consider their use in other tailwaters if a brook trout fishery becomes established.
6. Stock large trout (e.g., 12 inch fish) in selected hatchery-supported streams. The weight of each particular lot of stocked fish would remain the same, but would necessarily include fewer fish. Catch rates may be reduced, but some anglers may prefer the opportunity to catch larger fish. A creel of three 12-inch trout would weigh nearly the same as seven 9-inch trout, thus a corresponding reduction in the current creel limit may be appropriate where large trout are stocked.
7. Conduct opinion surveys periodically to make sure TWRA's management and trout angler preferences align as much as possible.

Public/Stakeholder Input: Establishment of more catch-and-release, delayed harvest, and other specially-regulated angling opportunities were, as a group, the most commonly-offered recommendations provided by stakeholders. Goal 4 strategies have been modified to reflect this preference. Additionally, the draft plan elicited comments both favoring and opposing strategy 6. Originally, this strategy applied to Goal 7 (optimize use of hatchery trout) and implied a broader application to hatchery-supported fisheries. Opponents speculated that such a change would be rejected by trout anglers at large and that enforcement would be ineffective. They also pointed out that a creel limit of three trout would be more restrictive than in any bordering state. However, most (80%) of the respondents who addressed this issue supported stocking larger fish coupled with a reduced creel limit. Given this input, it appears that a more limited use of this strategy would help achieve Goal 4.

GOAL 5. Increase access to trout fisheries.

Objective: Increase access to trout fisheries in tailwaters and hatchery-supported streams at 20 locations during the next 10 years.

Problems: Although all streams are public waters, the bottom of a stream is private property in Tennessee. Access is limited to most of our trout fisheries because of the lack of public ownership.

Strategies:

1. Purchase property on trout tailwaters that will provide strategic access points for float and wade fishing.
2. Purchase land along streams, then sell unwanted portions of these tracts to generate funds for purchasing access areas on other streams.
3. Seek a mechanism to provide a benefit (e.g., reduced property taxes) to landowners willing to permit public access to a trout fishery.

4. Request that the Tennessee Department of Transportation (TDOT) provide access where bridges are constructed or repaired.
5. Request legislative action to create laws that would allow recreational access to the river channel for fishing and travel by boat.

GOAL 6. Effectively communicate with all trout anglers.

Objective: Keep anglers informed on trout management issues and keep managers aware of angler concerns. Avenues of communication must be available to all anglers.

Problems: TWRA has a limited number of media outlets to share information and get feedback from anglers. Furthermore, it is very difficult to gauge opinions or determine a consensus among trout anglers because they represent several distinct groups. Some anglers are not willing to participate in public meetings designed to gather public input, yet they often become active after management decisions are made that negatively affect them. This makes it very challenging for TWRA to get input from the public prior to making management recommendations. Often the only groups that provide input or share opinions represent extreme viewpoints.

Strategies:

1. Develop regional focus groups that could be used to gauge interest in or support for various management options.
2. Conduct local public meetings to discuss trout management.
3. Encourage anglers to review the trout management plan.
4. Encourage anglers to review existing management plans for tailwater fisheries, and host a local public meeting to discuss updates to plans.
5. Continue collecting angler preference and satisfaction data via telephone.
6. Continue to welcome calls and emails submitted to TWRA.

GOAL 7. Optimize use of hatchery trout.

Objective: Ensure that all hatchery trout are used efficiently within designated programs.

Problems: The available supply of hatchery trout is limited, and many waters are being stocked at traditional rates that have not been rigorously evaluated. Some fisheries inherently require more trout than others, but there may be opportunities to reduce the number of trout stocked without impacting angler benefits.

Strategies

1. Emphasize wild trout management where feasible. Hatchery fish are most effectively used to provide trout fisheries where wild populations cannot be maintained. Where wild trout populations prove to be insufficient to support angling pressure, means for improving their abundance (e.g., improving habitat or reducing harvest) should be explored before stocking is initiated or expanded. Hatchery fish are currently used in some wild trout streams to meet demand, but the current scope and scale of such stocking should not be expanded.
2. Avoid excessive stocking rates by determining the minimum number of trout that can be stocked while still providing good fishing. This has been evaluated on some tailwaters, but research is needed on hatchery-supported streams and especially reservoirs to determine optimum stocking rates.
3. Promote new fisheries that use fewer hatchery trout. Delayed harvest areas are examples of fisheries that can be sustained with relatively few hatchery trout.
4. Select ponds or lakes rather than streams for new winter trout program events. Using ponds or lakes for winter fishing events will reduce the need for excessive numbers of fish and maximize benefits from those that are stocked. Even a moderate rain can cause high flows in streams during the winter season. High flows preclude fishing and can displace recently stocked trout. Therefore the likelihood of having low use of the stocked trout is much higher in streams.

GOAL 8. Produce more trout for hatchery-supported fisheries.

Objective: Produce an additional 150,000 pounds of trout annually.

Problem: Additional trout are needed to improve some tailwater fisheries, create new hatchery-supported streams and lakes, expand the winter trout program, and develop more kids fishing events.

Strategies:

1. Maintain existing production at TWRA's trout hatcheries by upgrading the existing infrastructure at hatcheries.
2. Add a liquid oxygen system to existing hatcheries to increase production and product quality where oxygen content of the rearing water is a limiting factor.
3. Purchase trout as needed from private sources to supplement TWRA production.
4. Build a new trout hatchery to produce 100,000 pounds of trout annually.
5. Use part of any increased production to provide and stock more brown trout, which often outperform rainbow trout and may be used to provide more quality angling opportunities (particularly in reservoirs).

GOAL 9. Improve the quality of stocked trout.

Objective: Improve the appearance of all trout stocked and use at least 10-inch fish in selected waters, especially hatchery-supported streams, winter stocking events, delayed harvest areas, and kids fishing derbies.

Problems: Trout do not have the opportunity to get larger where growth and survival rates are poor (e.g., in many hatchery-supported streams). Anglers obviously prefer to catch larger trout, thus TWRA should strive to stock fish that are at least 10 inches long. Combining numerous smaller fish with 10-inch trout can detract from an angler's fishing experience as the smaller fish are not appreciated. Another problem is the appearance of stocked fish. While the crowded conditions in hatchery raceways do not permit the production of trout with ideal appearances, there are times when hatchery fish can be in exceptionally poor condition (e.g., missing multiple fins). Reducing the number of low quality "finless" trout would be appreciated by the public.

Strategies:

1. Identify stocking events that require "high quality" trout.
2. Grade fish that are scheduled for events to assure that all fish are at least 10 inches.
3. Do not stock fish that fall short of the desired length. If some portion of the lot to be stocked is below the 10-inch target length, do not stock the short fish. It would be better to stock fewer fish than scheduled but provide a better product.
4. Fund hatchery improvements, such as liquid oxygen systems and increased flow, that would help improve the quality of the stocked trout.
5. Use the appropriate strain for a given management application by considering hatchery, field, and reproductive performance characteristics, as well as disease/stress resistance.

GOAL 10. Optimize habitat quality in tailwaters managed for trout.

Objective: Tailwaters managed for trout should meet state water quality standards (especially for dissolved oxygen) and provide minimum flows that benefit the existing trout fisheries.

Problems: Poor water quality and insufficient flows limit the recreational value of trout fisheries below some dams.

Strategies:

1. Request that the Tennessee Department of Environment and Conservation strictly enforce water quality standards where tailwater trout fisheries occur, as well as in tributaries to these tailwaters.
2. Support TVA's Reservoir Operation Study (ROS) initiatives to improve water quality and habitat below hydroelectric projects.

3. Ask federal representatives to support USACE initiatives to improve dissolved oxygen and minimum flows below Center Hill and Dale Hollow dams.
4. Increase public support for water quality and flow improvements by educating anglers about these issues.

GOAL 11. Manage reservoir trout fisheries for large fish.

Objective: Increase the size of trout harvested from reservoir fisheries.

Problems: Large reservoirs seem to offer great opportunities to grow large trout, yet Tennessee's reservoir trout fisheries are not typically producing these. Something is limiting the growth or survival of trout stocked in reservoirs, but TWRA does not currently monitor reservoir trout populations to identify bottlenecks in the system. Regulations to reduce harvest seem unnecessary because catch rates for trout on reservoirs are low. Regulations that promote catch-and-release would be ineffective during the summer because survival of trout released into warm surface waters after capture from deeper, cooler waters would be extremely low.

Strategies:

1. Evaluate the dynamics of reservoir trout populations and their prey species to determine what is limiting potential for large trout.
2. Determine which reservoirs can be managed to produce large trout.
3. Evaluate new trout strains or stocking sizes that may respond better to reservoir environments.
4. Evaluate current reservoir stocking rates for rainbow trout, brown trout, and lake trout and adjust where necessary. This will improve trout fishing in reservoirs and promote the efficient use of hatchery trout (supporting Goal 7).

GOAL 12. Make it easier to go trout fishing in Tennessee.

Objective: Provide anglers with the information needed to have safe, legal, and satisfactory trout fishing trips.

Problems: Anglers want to know as much as possible about a location before committing the resources to go fishing. Many new residents and non-resident anglers do not know where to go trout fishing. Many anglers are confused about license requirements and regulations. There is a common misconception that you do not need a trout license if you do not intend to harvest trout.

Strategies:

1. Maintain an up-to-date TWRA website containing maps of the hatchery-supported streams and winter trout program events.
2. Add tailwater access points to the trout website
3. Complete a wild trout fishing map and make it available on the website.
4. Develop and post signs identifying stocked streams. For example, the sign might read “stocked trout stream, fishing permitted, laws will be enforced”.
5. Clarify trout fishing regulations where necessary. Also make it clear to anglers and license agents that anyone who fishes for trout is required to have the appropriate licenses.
6. Make a one-day permit available to non-resident trout anglers. Currently, these anglers must purchase relatively expensive three-day or annual permits, which make it more difficult for them to access Tennessee’s trout fishing opportunities.

GOAL 13. Expand trout fishing opportunities for children.

Objective: Continue to provide trout for kid’s fishing derbies and develop new events that target young anglers (particularly in urban areas).

Opportunity/Problem: A kid’s fishing derby is a great opportunity to introduce children to fishing. Due to high participation rates at these events, trout are typically used efficiently. However, like other programs, kid’s fishing events are limited by trout availability.

Strategies:

1. All trout provided for kids fishing events should be at least 10 inches in length to maintain a quality fishing experience.
2. Event organizers should notify TWRA a year in advance to plan trout allocation.
3. Create new youth fishing events using existing fisheries in selected hatchery-supported streams or at winter trout program events (e.g., setting aside the first few days after stocking for kids only, similar to TWRA’s juvenile hunting programs).

GOAL 14. Develop more trout fisheries in middle Tennessee.

Objective: Develop at least three new hatchery-supported trout fisheries in middle Tennessee over the next 10 years.

Problems: Many of the traditional hatchery-supported fisheries in middle Tennessee have been lost during the last two decades because of reduced public access. Each time land is sold the existing access is at risk. During this period, the population of middle Tennessee has grown

substantially and many of the new residents are trout anglers from other states. Another problem is that despite the high demand for stocked trout, a few hatchery-supported streams are under-utilized because of concerns about access and a perception that the stream is always “fished out”.

Strategies:

1. Work with landowners on existing hatchery-supported streams to keep these areas open to the public. Inform landowners of laws exempting them from liability.
2. Make access a primary consideration for new fisheries. Streams with municipal greenways are likely candidates.
3. Do not use streams that already provide substantial fisheries for other species. Unlike natural fisheries, hatchery-supported streams receive high levels of use over short periods of time. Such fishing pressure could strain existing relations between landowners and anglers, causing anglers to lose access to waters they were formerly allowed to fish year-round.
4. Promote under-utilized fisheries in middle Tennessee by announcing stocking dates in press releases and asking landowners to post “fishing permitted signs”. Evaluate the fishery to determine if use is adequate to warrant continued stocking. If not, discontinue stocking in accordance with Goal 5.

GOAL 15. Maintain compliance with trout angling regulations.

Objective: Minimize the impacts of anglers who fail to comply with angling regulations (e.g., size limits, creel limits, and gear restrictions), particularly on tailwater trout fisheries.

Problem: Some trout anglers perceive that violations of angling regulations are damaging or limiting the potential of tailwater trout fisheries. This perception is reinforced because these anglers infrequently observe law enforcement activity or are unaware of its results.

Strategies:

1. Publicize results of law enforcement efforts on trout tailwaters in press releases, *Tennessee Wildlife* magazine, the TWRA website, and other outlets.
2. Request special or undercover law enforcement details in locations where multiple reports of violations are occurring.

Public/Stakeholder Input:

Complaints from some tailwater anglers about frequent violation of angling regulations and inadequate law enforcement were fairly common prior to the development of this plan. Several reviewers considered this an important issue and suggested that it be addressed.

GOAL 16. Limit threats posed by introduced exotic species and pathogens.

Objective: Minimize impacts to Tennessee's trout fisheries caused by introduced exotic species and pathogens.

Problem: The introduction and spread of invasive exotic species and pathogens such as whirling disease, New Zealand mud snails, and *Didymosphenia geminata* ("didymo") could potentially damage some trout fisheries. Didymo, which is a diatom (single-celled algae) that can form extensive mats on river bottoms, is already well-established in the South Holston and Wilbur tailwaters and has recently been observed in the Norris tailwater. Many anglers may be unaware of these threats.

Strategies:

1. Educate anglers and the public at large about which exotics threaten Tennessee trout fisheries and how their spread can be controlled. Use news releases, the agency website, *Tennessee Wildlife* magazine, and other sources to accomplish this task and provide periodic updates regarding the status of existing invasions and means for controlling them.
2. Actively participate in the USFWS National Wild Fish Health Survey to determine the distribution of certain pathogens in wild fish, thereby enabling managers to make risk assessments regarding stocked fish.
3. Maintain communication/cooperation with other agencies and anglers to quickly identify any new threats or invasions.

GOAL 17. Be prepared to meet Tennessee's future trout management challenges.

Objective: Maintain a comprehensive trout management plan that is capable of addressing contemporary needs.

Opportunity/Problem: Changing trout angler preferences and attitudes, along with new challenges and resource management issues, will require that management goals, objectives, and strategies be periodically re-evaluated and adjusted.

Strategies:

1. Update Tennessee's trout management plan at least every 10 years to ensure that it continues to provide the guidance necessary for wisely managing Tennessee's trout fisheries. Involve stakeholders in the revision process.

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